United States
Department of
Agriculture

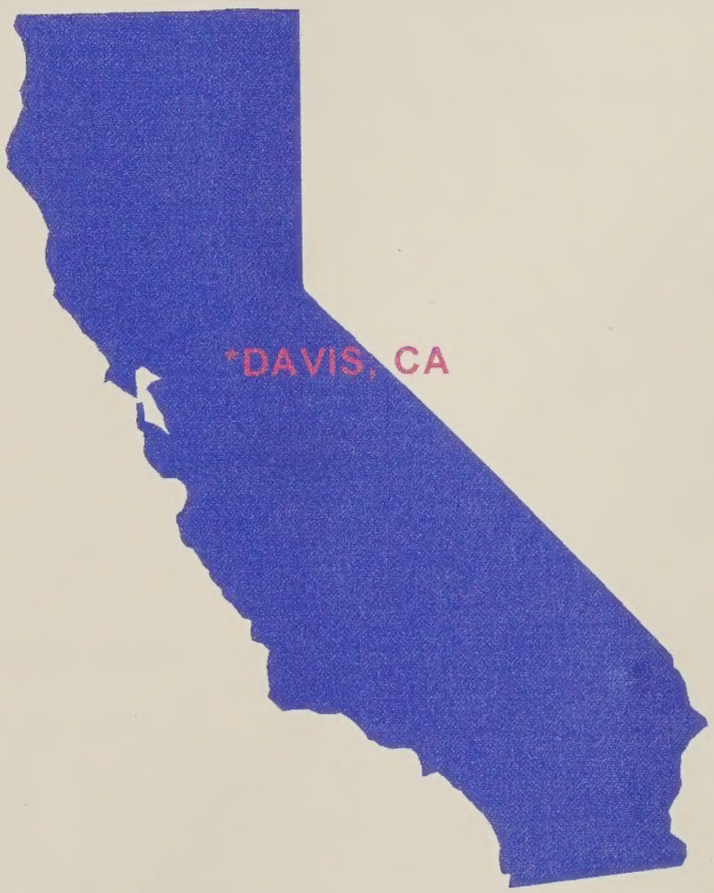
Forest Service

Forest Pest
Management

Davis, CA

FPM/DAVIS OFFICE

ACCOMPLISHMENT REPORT -



FY 94

FPM 94-16
September 1994

Pesticides used improperly can be injurious to human beings, animals, and plants. Follow the directions and heed all precautions on labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.

FPM 94-16
September 1994

FY 94 Accomplishment Report - FPM/Davis Office Pesticide Application Technology

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INTRODUCTION

WO/FPM Davis Staff

The WO/FPM Davis Pesticide Application Technology Group is responsible for coordinating application technology and is the only group in the USDA Forest Service with this mission. The staff consists of a program manager, a computer programmer analyst, and an administrative assistant. The administrative assistant is provided on detail by the USDA Soil Conservation Service (SCS), California State Conservationist, through a shared-services agreement. Administrative services eg. office space, mail, limited purchasing, and duplication services are also provided by SCS. We are very fortunate to be housed with and receive such fine support from our USDA partner.

Our primary contractors are Continuum Dynamics, Inc. (CDI) of Princeton, NJ, and the Missoula Technology and Development Center (MTDC). Work performed by CDI is integrated in this accomplishment report. Work by MTDC and their FY 94 accomplishments are reported in a separate report.

The accomplishments reported herein were possible through partnerships with other FS units, other State and federal agencies, academia, and industry. We especially acknowledge the outstanding contributions made by Drs. Milt Teske, CDI, and Harold Thistle, MTDC. Names of other cooperators are listed under specific goals and accomplishments.

The FY 94 combined administrative and technical budget, less salaries of the program manager and computer programmer analyst, was $274K.

Major Activities

Our major activities over the past several years have included:

• Coordinating national pesticide application technology within and outside the Forest Service;

• Coordinating national pesticide use management training;

• Chairing four standing national steering committees;

• Developing partnerships with industry (equipment manufacturers and biological pesticide companies), other agencies, and academia to develop, evaluate, and transfer technology;

• Conducting technology transfer through publication of reports; editing of papers, book chapters, and books; conducting training and workshops; and presentation of posters and papers at professional meetings;

• Providing technical consultations to federal, state, academia, and industry in safe and efficient aerial use of pesticides. FSCBG aerial spray and fate model is used to assist in these consultations;

• Providing information and reports to FS and cooperators on application technology and maintaining a library of references, reports, and publications;

• Seeking opportunities domestically and internationally in building partnerships for short-term, high pay-off technology; and

• Serving as FPM Sponsor/Coordinator of the FPM program at the Missoula Technology and Development Center and providing technical direction of the program.

Emerging Opportunities

The FPM Davis staff is well positioned to support ecosystem management and the forest health initiatives. Pesticides, especially the biorational materials such as biopesticides and pheromones, will be required to support ecosystem management and forest health objectives. There are emerging needs to pursue development of pest management methodologies and equipment using natural compounds and organisms. Such work will be especially important in managing exotic pests, both current and future introductions. We see exotics as the major threat to ecosystem management and biodiversity. If the pattern continues, USDA-ARS will focus on agricultural research, while Forest Service research will focus on basic forest research. This leaves FPM responsible for coordinating applied research, and development of methodologies and equipment to support application and dispersal of natural compounds and organisms for use in forestry.

FPM WORK PLAN ACCOMPLISHMENTS

Introduction

Task accomplishments are presented in the order that the task appears in the FY 94 FPM work plan document. In addition to work plan accomplishments other activities beyond the work plan were accomplished and are reported beginning on page 25 of this report.

GOAL #1: MAXIMIZE FOREST PEST MANAGEMENT EFFICIENCY WHILE MINIMIZING ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS ON LAND OF ALL OWNERSHIPS

OBJECTIVE #1: IMPROVE FPM NATIONAL DIRECTION

TASK:

31. Coordinate draft of a plan for national and international pesticide use and management training. Barry (09/94)

ACCOMPLISHMENT: Draft of an outline plan prepared and sent to pesticide coordinators, course faculty, and steering committee members for comment. International sponsorship of pesticide use and management training has been discussed with representatives of Canadian Forest Service, Mexican Forest Service, New Zealand Forest Research Institute, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service. Representatives of these countries and agencies support the concept of a cooperative co-sponsored training program.

GOAL #1: MAXIMIZE FOREST PEST MANAGEMENT EFFICIENCY WHILE MINIMIZING ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS ON LANDS OF ALL OWNERSHIPS

OBJECTIVE #3: IMPROVE PEST MANAGEMENT DELIVERY SYSTEM AT ALL LEVELS

TASK:

18. Prepare proposals for cooperation with Russia for transfer of pesticide application technology and for training field level personnel. Barry/Cota (09/94)

ACCOMPLISHMENT: Prepared and submitted proposal to WO on October 14, 1993. Proposal covered training of two Russian scientists in U.S. Proposal was approved and funded. Barry coordinated/hosted Andre P. Raspovo and Elena G. Kulikova at the Marana pesticide course during the period March 15-30, 1994. This was a high payoff venture given the exchange of technical information and the important one-on-one contacts that were established.

GOAL #1: MAXIMIZE FOREST PEST MANAGEMENT EFFICIENCY WHILE MINIMIZING ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS ON LANDS OF ALL OWNERSHIPS

OBJECTIVE #3: IMPROVE PEST MANAGEMENT DELIVERY SYSTEM AT ALL LEVELS

TASK:

20. Develop a plan for a national database that will catalogue, enter, and retrieve publications and reports related to pesticide application. Skyler/Whitmire (09/94)

ACCOMPLISHMENT: In cooperation with Washington Office Information Systems and Technology staff all FPM/Davis library reports and publications are being entered into the Forest Service INFO database. This database will be accessible internationally. Over 250 reports/publications from the FPM/Davis library dated 1990 to present were submitted to WO/IS&T for entry into the database (07/94). All reports/publications in the FPM/Davis library dated prior to 1990 that are not currently in the FS INFO database are in the process of being entered into the database by FPM/Davis staff.

In addition, the report entitled "Bibliography of Pesticide Application Technology" (FPM 91-9) is being updated (September 1994) to include all 14 categories of reports/publications currently in the FPM/Davis library. The bibliography will continue to be updated as FPM and other reports/publications on application technology are added to the FPM/Davis library. All reports/publications added to the FPM/Davis library will continue to be sent to WO/IS&T for inclusion in the Forest Service INFO database.

We appreciate the fine cooperation and guidance provided by Seung Ja Sinatra of IS&T in support of this task.

GOAL #1: MAXIMIZE FOREST PEST MANAGEMENT EFFICIENCY WHILE MINIMIZING ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS ON LANDS OF ALL OWNERSHIPS

OBJECTIVE #3: IMPROVE PEST MANAGEMENT DELIVERY SYSTEM AT ALL LEVELS

TASK:

22. Coordinate FPM development projects at MTDC. Barry (09/94)

ACCOMPLISHMENT: Served as FPM Sponsor/Coordinator of the FPM program at MTDC. MTDC is one of the prime FPM contractors for application technology. Significant progress was realized in FY 94 (see MTDC accomplishment report). The MTDC/FPM 5-Year Program Plan has been updated. MTDC work in FY 94 extended to NA, R-5, R-1, and NARTC. Their support of the Marana pesticide course was outstanding. Significant progress has been made at MTDC on spray block marking, pheromone application, meteorology and modeling, single-tree sprayer, aircraft GPS guidance, and thermal insect control projects.

We recognize the contributions at MTDC by Dr. Harold Thistle, Dave Rising, Thelma Norskog, and Terry Solberg for their management of the MTDC/FPM Program.

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OBJECTIVE #3: IMPROVE PEST MANAGEMENT DELIVERY SYSTEM AT ALL LEVELS

TASK:

23. Coordinate FSCBG/AGDISP user training and conduct model runs for FS and cooperators. Skyler (09/94)

Note: FSCBG (Forest Service-Cramer-Barry-Grim) is a computer model which predicts the behavior of spray material after it is released through nozzles into the wake of a spray aircraft, traveling through real atmospheric effects, penetrating canopy (trees or crops), and impacting the ground. The development of FSCBG was accomplished through partnership between USDA Forest Service, Forest Pest Management, Washington Office, and U.S. Army Dugway Proving Ground, UT. In 1994 the FSCBG User Group currently has 79 active members. The model is being used nationally and internationally and is being adapted by Environment Canada and U.S. EPA as a pesticide regulatory system.

ACCOMPLISHMENT: Completed 18 FSCBG model runs and prepared a report of the results for Dr. Paul Jellema, Plant Protection Service, The Netherlands. The model runs were requested by Dr. Jellema to look at deposition due to drift after aerial application and to gain a better understanding of drift to surface water after aerial application. (11/93)

Demonstrated capabilities of the FSCBG model to Steve Nicholson, Novo Nordisk, Ontario, Canada and Dr. Imre Otvos, Forestry Canada, Victoria, B.C. on February 17, 1994, at the FPM/Davis office.

Demonstrated FSCBG model to students at the FPM national pesticide course, Marana, AZ and assisted with student discussions, problem solving, etc. involving case studies of FSCBG model runs. (03/94)

Completed FSCBG model runs for Dr. Harold Thistle, Missoula Technology and Development Center, to look at net radiation - stable vs unstable conditions. (03/94)

Assisted Dr. Scott Cameron, Texas Forest Service, with FSCBG model runs by reviewing inputs and suggesting various changes. The model run results were used

by Mr. Cameron for a presentation to Champion International. (05/94)

Completed FSCBG comparison model runs using 1992 Charter almond orchard study data to compare effects of three aircraft and airspeed on spray deposition and drift patterns. (05/94)

The FSCBG model was demonstrated to Dr. Humphrey Elliott, Chief, Division of Silvicultural Research and Development, Forestry Commission, Tasmania, Australia and Jim Conley of Entotech, Davis, CA. on June 16, 1994 at the FPM/Davis office.

The FSCBG model was demonstrated to Dr. James L. Smith, Division of Phytosanitary Protection, Bioforest LTDA, Valdivia, Chile on June 9, 1994, at the FPM/Davis office. Dr. Smith joined the user group after the demonstration.

Assisted Dr. Peter Alexander, Food Research Institute, Australia with FSCBG model runs by reviewing and discussing model inputs. Purpose of the model runs was to look at a real-world, long-range herbicide drift problem. (06/94)

Completed FSCBG model runs for Temple Bowen, Novo Nordisk, Danbury, CT, to look at swath width, deposition, and drift using a Mielec Antonov biplane. This is in support of the Nun moth problem in Poland. (06/94)

Completed FSCBG model runs for Dr. Dan Byers, Colorado State University, Department of Fishery and Wildlife Biology, Fort Collins, CO, to look at drift into a no-spray buffer zone using variable wind speeds. Dr. Byers is working for APHIS in support of the grasshopper program risk assessment. (08/94)

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OBJECTIVE #3: IMPROVE PEST MANAGEMENT DELIVERY SYSTEM AT ALL LEVELS

TASK:

25. Develop a PUM&C strategic plan for the 1990's. (Submit to printer by completion date.) Barry/Cota (04/94)

ACCOMPLISHMENT: Draft that reflected FS and State cooperator's input was submitted to WO/FPM on March 15, 1993, and provided WO/FPM comments on subsequent drafts. WO/FPM further revised and distributed draft to Regions, NA, and Stations.

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OBJECTIVE #3: IMPROVE PEST MANAGEMENT DELIVERY SYSTEM AT ALL LEVELS

TASK:

27. Coordinate the planning and conduct of the National Pesticide Training course at NARTC/Marana. Barry (09/94)

ACCOMPLISHMENT: Course was conducted during March 1994. A total of 55 students from cooperating state and federal agencies, Russia, Canada, and Mexico attended the two-week course. The four-module concept, whereas students elected the modules they wished to attend, worked well for the faculty and students alike. This approach saved money by reducing time on site. Costs were reduced by avoiding "fee type" instructors. Course critiques by students and instructors were highly positive with suggestions to expand the course sponsorship internationally.

The course was well delivered and a big success. All four module leaders, Julie Weatherby, Jim Hadfield, Ed Monnig, and Jim Brown were recognized with cash awards.

The NARTC staff is recognized for their fine support of this fourth pesticide course at the Marana facility.

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OBJECTIVE #3: IMPROVE PEST MANAGEMENT DELIVERY SYSTEM AT ALL LEVELS

TASK:

28. Develop computer-based budget record-keeping system for FPM/Davis office. Whitmire (09/94)

ACCOMPLISHMENT: Coordinated retrieval of FS software program BMANOTES from R-1 and worked with DG system manager in getting the program installed and running on the R05H system. Use BMANOTES to track FPM/Davis account obligations and charges, and to provide monthly reports of expenses and account balances to the Program Manager.

Our thanks to Bruce Jeske, R-1, and James Whiteside, R-5, Regional Aviation Group, for their assistance with this project.

GOAL #1: MAXIMIZE FOREST PESTICIDE MANAGEMENT EFFICIENCY WHILE MINIMIZING ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS ON LANDS OF ALL OWNERSHIPS

OBJECTIVE #4: REDUCE ADVERSE ENVIRONMENTAL EFFECTS FROM THE USE OF PESTICIDES

TASK:

03. Chair two national steering committees - Western Defoliators, Seed and Cone. Barry (09/94)

ACCOMPLISHMENT: The western defoliator committee meeting was held at Spokane, WA, April 12-13, 1994; and the seed and cone steering committee was held at Rhinelander, WI, June 28-30, 1994. Technical development needs were identified and sent to Director, FPM, August 2, 1994. Five-year tactical plan for seed, cone, and regeneration insects has been revised and the strategic/tactical plan for western defoliators has been completed.

We appreciate the significant efforts of John Wenz, R-5, and the other committee members who developed the 5-year strategic/tactical plan for western defoliators.

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OBJECTIVE #4: REDUCE ADVERSE ENVIRONMENTAL EFFECTS FROM THE USE OF PESTICIDES

TASK:

04. Chair National Spray Model Advisory Committee. Barry (09/94)

ACCOMPLISHMENT: The committee's new name is National Spray Model and Application Technology Steering Committee. Meeting was held at Kansas City, MO, June 22, in conjunction with the 1994 summer meeting of the American Society of Agricultural Engineers (ASAE) and was attended by engineers and scientists representing state and federal agencies, industry, and academia. The committee provides an important link for scientists and engineers who work on pesticide application methods and equipment. Notes of the meeting are in draft.

We appreciate the cooperation of the ASAE in providing a meeting room and AV support.

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OBJECTIVE #4: REDUCE ADVERSE ENVIRONMENTAL EFFECTS FROM THE USE OF PESTICIDES

TASK:

07. Chair the drafting and completion of 5-year Tactical Plans for the national steering committees. Barry (09/94)

ACCOMPLISHMENT: The 5-year tactical plans for the gypsy moth and seed and cone national steering committees have been completed and distributed. The seed and cone plan has been updated and will be distributed September 1994. The strategic/tactical plan for the western defoliator steering committee has been completed and will be distributed September 1994. Preparation and updating these plans provide opportunities for researchers, applied scientists, and resource managers from state and federal agencies, industry, and academia to interact and form partnerships. One could argue with success that the combined package of steering committee tactical plans makes up a major part of the national FPM program.

We recognize the commitment of the Director, FPM, the field FPM Directors, and the committee members to the national steering committee and technology development program.

GOAL #1: MAXIMIZE FOREST PEST MANAGEMENT EFFICIENCY WHILE MINIMIZING ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS ON LANDS OF ALL OWNERSHIPS

OBJECTIVE #5: DEVELOP, UPDATE, AND/OR IMPROVE INFORMATION DATA GATHERING SYSTEMS

TASK:

11. Coordinate, gather, and update data-base of annotated bibliography of western defoliator field experiments, pilot, demonstration, and other projects and distribute to users. Skyler (09/94)

ACCOMPLISHMENT: This project was initiated upon recommendation of the western defoliator steering committee in 1989. Pat Skyler annually coordinates with the Western Regions to obtain information on current projects. Data on 1993 western defoliator aerial spray projects were gathered and entered into the database. Report was updated and mailed to FPM Directors and steering committee members on July 1, 1994.

We appreciate the work of Julie Weatherby and Joy Roberts, FPM/Boise Field Office, in initially setting up this database.

GOAL #1: MAXIMIZE FOREST PEST MANAGEMENT EFFICIENCY WHILE MINIMIZING ADVERSE ENVIRONMENTAL AND SOCIAL IMPACTS ON LANDS OF ALL OWNERSHIPS

OBJECTIVE #6: ENCOURAGE APPLICATION OF NEW TECHNOLOGY DEVELOPED BY RESEARCH TO ENABLE FOREST PEST MANAGEMENT TO MEET FS COMMITMENT TO INTEGRATED PEST MANAGEMENT

TASK:

01. Serve as COR for FSCBG model enhancements evaluation and technology transfer contract. Barry (09/94)

ACCOMPLISHMENTS: This contract, which covers the enhancement of the FS developed Forest Service-Cramer-Barry-Grim (FSCBG) aerial spray model, was awarded on December 20, 1993. The overall goal of this contract is to develop and evaluate technologies that support the safe, environmentally sound and efficient use of biological and other pesticides. Technology transfer is a major emphasis. During FY 94, 17 tasks were assigned to the contractor for completion no later than the end of FY 95. Several reports and publications resulted from this project in 1994 as listed in this report. New Zealand is using FSCBG to plan aerial herbicide operations; Canada will likely adapt it to assist in pesticide registration, and the US EPA also plans to adapt it for regulatory purposes.

We recognize the partnerships with Dr. Brian Richardson, New Zealand Forest Research Institute and Dr. Bob Mickle, Environment Canada, for their scientific contributions and technology transfer of the model. We also express our appreciation to Dr. Milt Teske, contracting engineer, for his sustained superior performance in responding to FS technical needs and supporting technology transfer of the model.

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OBJECTIVE #6: ENCOURAGE APPLICATION OF NEW TECHNOLOGY DEVELOPED BY RESEARCH TO ENABLE FOREST PEST MANAGEMENT TO MEET FS COMMITMENT TO INTEGRATED PEST MANAGEMENT

TASK:

02. Cooperate with USDA-APHIS, USDA-ARS, and NEFAAT in pesticide application technology. Barry (02/94)

ACCOMPLISHMENT: FSCBG model runs made for grasshopper risk assessment at request of Tim Roland, APHIS, and cooperated with Linda Abbott, APHIS, on gypsy moth risk assessment.

Representatives of APHIS, ARS, and NEFAAT are included on the National Spray Model and Application Technology Steering Committee. Committee meets annually and provides input to FPM/MTDC technology development program and other cooperative technology transfer activities.

Interacted with NEFAAT representatives in areas of training, FSCBG model use, spread factor technology, meteorological studies, and application technology strategic planning.

Established contact with Dr. Bill Hollis, ARS, Beltsville, to coordinate application technology; with Drs. Neal Spencer and Norm Rees, ARS, biocontrol of weeds project; Dr. W. Lamar Harris, APHIS National Program Leader; and Dr. Iran Kirk, ARS, College Station, concerning cooperation with FSCBG and AGDISP models, and application technology. Seeking partnerships with these agencies in advancing spray drift management and transfer of FS application technology.

Participated in U.S. Fish and Wildlife Service National Pest Management Coordinators meeting at Willows, CA. Presented a talk on FS pesticide training and activities of the Davis Pesticide Application Technology Group.

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OBJECTIVE #6: ENCOURAGE APPLICATION OF NEW TECHNOLOGY DEVELOPED BY RESEARCH TO ENABLE FOREST PEST MANAGEMENT TO MEET FS COMMITMENT TO INTEGRATED PEST MANAGEMENT

TASK:

03. Report results of Bt environmental fate studies conducted during the 1992 Gypsy Moth Eradication program in Utah. Barry/Skyler (09/94)

ACCOMPLISHMENT: Data on the meteorological measurements have been reported (9334-2828-MTDC).

Results of the Bt spray penetration and deposition in Gambel oak canopies was reported at the 1994 summer meeting of the Agricultural Engineers (ASAE Paper No. 941031).

A report titled *Bacillus thuringiensis* Drift Deposits on Gambel Oak Foliage - 1992 Utah Gypsy Moth Eradication Project was prepared (FPM 94-13). This reports on recoveries of Bt drift on Gambel oak foliage and compares recoveries to those on physical samplers.

Preliminary data will be presented at the national gypsy moth review.

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OBJECTIVE #6: ENCOURAGE APPLICATION OF NEW TECHNOLOGY DEVELOPED BY RESEARCH TO ENABLE FOREST PEST MANAGEMENT TO MEET FS COMMITMENT TO INTEGRATED PEST MANAGEMENT

TASK:

04. Coordinate technology development and cooperative projects with Forest Research Institute, New Zealand. Barry (09/94)

ACCOMPLISHMENT: Dr. Harold Thistle (MTDC) and Dr. Milt Teske (CDI, Inc.) visited the Forest Research Institute, NZ, in January 1994 to conduct a cooperative workshop on the FSCBG spray and environmental fate model. They briefed NZ regulators on proposed use of the FSCBG model by U.S. and Canada in the regulatory processes. They also discussed a series of cooperative studies with NZ that Jack Barry proposed be conducted jointly with NZ. Discussions and planning will continue with Brian Richardson, NZ, when he visits FPM/MTDC at Missoula, MT, October 8-18, 1994. We look to joint field trials in NZ during 1995.

Thanks to Drs. Thistle and Teske for building the partnership with NZ-FRI and the hospitality and cooperation provided by Dr. Brian Richardson and his colleagues at FRI.

GOAL #2: MAXIMIZE INTERNAL AND PUBLIC TRUST IN FOREST SERVICE PEST MANAGEMENT PROGRAMS

OBJECTIVE #1: IMPROVE PEST MANAGEMENT KNOWLEDGE AND AWARENESS AT ALL LEVELS. ENABLE FOREST PEST MANAGEMENT TO MEET FS COMMITMENT TO INTEGRATED PEST MANAGEMENT

TASK:

13. Write and edit the monthly issue of the pesticide newsletter. Skyler (09/94)

ACCOMPLISHMENT: The pesticide newsletter "Short Subjects and Timely Tips for Pesticide Users" is compiled, edited, and mailed out to over 200 addressees monthly. Favorable comments on the letter are being received from many sources.

Our thanks to all those who have contributed and continue to contribute articles and other items of interest for inclusion in this monthly publication.

GOAL #2: MAXIMIZE INTERNAL AND PUBLIC TRUST IN FOREST SERVICE PEST MANAGEMENT PROGRAMS

OBJECTIVE #1: IMPROVE PEST MANAGEMENT KNOWLEDGE AND AWARENESS AT ALL LEVELS. ENABLE FOREST PEST MANAGEMENT TO MEET FS COMMITMENT TO INTEGRATED PEST MANAGEMENT

TASK:

15. Survey alumni of the NARTC national pesticide courses, analyze replies, and prepare report. Barry/Skyler (09/94)

ACCOMPLISHMENT: A survey was prepared and mailed to alumni of the three national pesticide use management courses, and the results summarized in a report entitled *National Pesticide Management Course Alumni Questionnaire - A Post Evaluation of the 1986, 1989, and 1991 Courses* (FPM 94-1, October 1993). We experienced a high rate (48%) of return with positive comments on the survey method and the Marana training program. Alumni answered numerous questions which will be most helpful in developing future courses. Included were a prioritized list of subjects the alumni want to see in future courses.

Our thanks to all those who took the time to respond to the survey.

GOAL #2: MAXIMIZE INTERNAL AND PUBLIC TRUST IN FOREST SERVICE PEST MANAGEMENT PROGRAMS

OBJECTIVE #1: IMPROVE PEST MANAGEMENT KNOWLEDGE AND AWARENESS AT ALL LEVELS. ENABLE FOREST PEST MANAGEMENT TO MEET FS COMMITMENT TO INTEGRATED PEST MANAGEMENT

TASK:

16. Prepare and distribute "FSCBG Model Technology Transfer Notes." Skyler (09/94)

ACCOMPLISHMENT: A 23-page FSCBG/AGDISP model technology transfer information letter, which included a bibliography, was prepared and mailed (04/94) to over 170 addressees including FSCBG user group members and cooperators, and international partners. We enjoy a broad-based contribution to this information letter. Responses to this information letter have been highly supportive which reflect the high quality of articles submitted by contributors. Addressees clearly appreciate the information sharing.

OTHER ACCOMPLISHMENTS

1. Participated in co-op technology transfer project conducted January and February 1994 - USDA Forest Service (WO/FPM Davis and MTDC), University of California Extension (Davis) - State IPM Program, Hennigan Orchards, Inc., and Entotech, Inc. Four aerial treatments of almond orchard using *Bacillus thuringiensis* to control peach twig borer. FSCBG model evaluated and FS technology transferred to agriculture use through cooperative efforts. FS gains information on canopy penetration and drift and the study provided data to evaluate FSCBG.

2. Cooperated in helicopter wake study tests conducted in Yuba City, CA, July 25-29, 1994. Cooperative project between USDA Forest Service Intermountain Fire Science Laboratory, Missoula MT and Forest Pest Management, WO/Davis, CA; U.S. Army Dugway Proving Ground; and Continuum Dynamics, Inc. Study objective is to characterize side wash from aircraft to assess personnel hazards, fire fanning and spread, pesticide drift, and dust/debris hazards.

3. Participated in developing NCFH 5-year plan at Denver, CO, at request of Dr. Bov Eav. This was a well coordinated and productive session. We appreciate the opportunity to participate in this productive planning session.

4. Organized and conducted a one-day seminar at Davis for visiting Canadian scientists and industry on FSCBG model, application technology, FS technology development program, and environmental fate of pesticides.

5. Served as chair of day-long session on biorational control agents at American Chemical Society meeting, San Diego, CA, March 16-17, 1994.

6. Served as co-editor with Dr. Frank Hall, Ohio State University, of an American Chemical Society book titled *Biorational Pest Control Agents: Formulation and Delivery.* Hardcover book to be published by ACS in 1995.

7. Instigated development and field test of single tree spray system designed to spray and protect isolated stands in R-5 of rust resistant sugar pine. Assigned project to MTDC. Field test was successful and system is being evaluated in Sierra NF and in a Region 1 seed orchard. Thanks to MTDC for their quick response to this project.

8. Cooperated with University of California Davis Extension in monitoring Bt drift from Curtec spray system used experimentally by City of Davis to control elm leaf beetle in urban ecosystem.

9. Contributed article Aerial Application to Forests in a book titled *Application Technology for Crop Protection*, published 1993 by CAB International, UK.

10. Co-authored article Aerial Spray Drift in *Environmental Modeling Vol. II: Computer Models and Software for Simulating Environmental Pollution and Its Adverse Effects.*

11. Initiated Bt in soil studies to address Bt fate data gaps. NOVO, Abbott Labs, R-4, and State of Utah are partners.

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Barry, J.W. 1993. Supplement to sixth report - National steering committee for management of gypsy moth and eastern defoliators - USDA APHIS pesticide evaluation reports. FPM 94-3. USDA Forest Service, Forest Pest Management, Davis, CA.

Barry, J.W. 1993. Memorandum report - National meeting U.S. Fish and Wildlife Service pest management coordinators. Sacramento Valley National Wildlife Refuge Complex, Willows, CA.

Barry, J.W. 1994. *Fifth report* - National spray model steering committee. FPM 94-15. USDA Forest Service, Forest Pest Management, Davis, CA.

Gay, B.P. and D.P. Segers. 1994. Specialized laboratory support (Task TA-31) - Droplet evaporation. FPM 94-9. USDA Forest Service, Forest Pest Management, Davis, CA.

MacNichol, A.Z. and M.E. Teske. 1994. FSCBG model comparisons with the 1991 Davis virus spray trials. FPM 94-2. Prepared under Contract No. 53-0343-1-00153 by Continuum Dynamics, Inc. for USDA Forest Service, Forest Pest Management, Davis, CA.

MacNichol, A.Z. 1994. C-47 aircraft spray deposition - Part 1: A statistical interpretation. FPM 94-11. Prepared under Contract No. 53-0343-1-00153 by Continuum Dynamics, Inc. for USDA Forest Service, Forest Pest Management, Davis, CA.

MacNichol, A.Z. and M.E. Teske. 1994. FSCBG model comparisons - 1974 Rennic Creek spray trials. FPM 94-12. Prepared under Contract No. 53-0343-1-00153 by Continuum Dynamics, Inc. for USDA Forest Service, Forest Pest Management, Davis, CA.

MacNichol, A.Z. 1994. User manual for the spread factor database. FPM 94-14. Prepared under Contract No. 53-0343-1-00153 by Continuum Dynamics, Inc. for USDA Forest Service, Forest Pest Management, Davis, CA.

Members, National Steering Committee for Management of Gypsy Moth and Eastern Defoliators. 1994. Tactical plan - National steering committee for management of gypsy moth and eastern defoliators. FPM 94-5. USDA Forest Service, Forest Pest Management, Davis, CA.

Members, National Steering Committee for Management of Seed, Cone, and Regeneration Insects. 1994. Tactical plan - National steering committee for management of seed, cone, and regeneration insects. FPM 94-6. USDA Forest Service, Forest Pest Management, Davis, CA.

Members, National Steering Committee for Management of Western Defoliators. 1994. Tactical/Strategic plan - National steering committee for management of western defoliators. FPM 94-7. USDA Forest Service, Forest Pest Management, Davis, CA.

Onken, A., R. Reardon, and J. Barry. 1994. *Diflubenzuron* database. FHM NC-02-94. USDA Forest Service, National Center of Forest Health and Management, Morgantown, WV.

Skyler, P.J. and J.W. Barry. 1993. National pesticide management course alumni responses to questionnaire - A post evaluation of the 1986, 1989, and 1991 courses. FPM 94-1. USDA Forest Service, Forest Pest Management, Davis, CA.

Teske, M.E. and T.B. Curbishley. 1994. Forest Service aerial spray computer model FSCBG 4.3 - User manual extension. FPM 94-10. Prepared under Contract No. 53-0343-1-00153 by Continuum Dynamics, Inc. for USDA Forest Service, Forest Pest Management, Davis, CA.

Teske, M.E. 1994. *Bacillus thuringiensis* drift deposits on Gambel oak foliage - 1992 Utah gypsy moth eradication project. FPM 94-13. Prepared under Contract No. 53-0343-1-00153 for USDA Forest Service, Forest Pest Management, Davis, CA.

Zalom, F., B. Hennigan, J. Connell, G. Kirfman, J. Conley, C. Kitayana, H. Thistle, and J. Barry. 1994. Study plan - Hennigan orchard study 1994 - Evaluation of *Bacillus thuringiensis* to control peach twig borer. FPM 94-4. USDA Forest Service, Forest Pest Management, Davis, CA.

PAPERS PRESENTED, POSTERS, AND JOURNAL PUBLICATIONS - FY 94

Barry, J.W. 1993. Aerial application to forests (Chapter 12). In *Application Technology for Crop Protection*, eds. G.A. Matthews and J.C. Hislop, 241-273. Wallingford: CAB International.

Flake, H.W., M.E. Teske, and J.W. Barry. 1993. FSCBG spray width predictions. Paper No. AA93-003. Presented at *27th annual convention and exposition of the national agricultural aviation association (NAAA)*. Reno, NV, 6 December.

Smith, D.B., M.H. Willcutt, D.L. Valcore, J.W. Barry, and M.E. Teske. 1993. Guidelines for aerial atomization and spray drift reduction for Mississippi applicators. Information Bulletin 251. Mississippi Agricultural & Forestry Experiment Station, Mississippi State, MS.

Teske, M.E., A.Z. MacNichol, and J.W. Barry. 1993. USDA Forest Service spread factor technology database. Presented at *ASTM 14th symposium on pesticide formulations and application systems*. Fort Worth, TX, 12-13 October.

Teske, M.E., J.W. Barry, and H.W. Thistle, Jr. 1994. Environmental fate and accountancy. Presented at *ACS symposium - Biorational pest control agents: Formulation and delivery*. San Diego, CA, 16-17 March.

Teske, M.E., J.W. Barry, and J.E. Rafferty. 1994. An examination of spray penetration through scrub oak canopies. Paper No. 94-1031. Presented at *ASAE 1994 international summer meeting*. Kansas City, MO, 19-22 June.

Teske, M.E., J.W. Barry, and J.H. Ghent. 1994. Aircraft deposit coverage over canopies. Paper No. 94-1033. Presented at *ASAE 1994 international summer meeting*. Kansas City, MO, 19-22 June.

Teske, M.E., A.Z. MacNichol, and J.W. Barry. 1994. USDA Forest Service spread factor technology database. In *Pesticide Formulations and Application Systems: 14th Volume, ASTM STP 1234*, eds. F.R. Hall, P.D. Berger, and H.M. Collins, Philadelphia: American Society for Testing and Materials.

Teske, M.E., J.W. Barry, and H.W. Thistle, Jr. 1994. Aerial spray drift modeling. In *Environmental Modeling Vol. II: Computer Methods and Software for Simulating Environmental Pollution and Its Adverse Effects*, ed. P. Zannetti, 11-42. Southhampton: Computational Mechanics Publications.

Thistle, H.E., J.W. Barry, and M.E. Teske. 1993. Computing total accountancy of aerially released material. Presented as a poster at *Society of environmental toxicology and chemistry 14th annual meeting - Ecological risk assessment: Lessons learned?* Houston, TX, 14-18 November.

Zalom, F., J. Barry, W. Johnson, G. Kirfman, J. Conley, and J. Connell. 1994. Bloomtime aerial applications of *Bacillus thuringiensis* for control of peach twig borer. Presented as a poster at *Second national IPM symposium/workshop*. Las Vegas, NV, 19-22 April.

United States
Department of
Agriculture

Forest Service

MTDC
Missoula, MT

MISSOULA TECHNOLOGY AND DEVELOPMENT CENTER

FOREST PEST MANAGEMENT PROGRAM

ANNUAL REPORT -

FY 93 AND FY 94 ACCOMPLISHMENTS

Appendix to FPM 94-16
September 1994

Pesticides used improperly can be injurious to human beings, animals, and plants. Follow the directions and heed all precautions on labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.

Appendix to
FPM 94-16
September 1994

Missoula Technology and Development Center - Annual Report FY 93 and FY 94 Accomplishments Forest Pest Management Program

Prepared by:

Harold Thistle
Title: Project Leader

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Development Center
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John W. Barry
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MISSOULA TECHNOLOGY AND DEVELOPMENT CENTER

ANNUAL REPORT

FY 93 AND FY 94 ACCOMPLISHMENTS

FOREST PEST MANAGEMENT PROGRAM

Missoula Technology and Development Center (MTDC) and Forest Pest Management (FPM) developed a Five-Year Program Work Plan (Plan) that was approved by Director, Forest Pest Management in FY 92. Work began under this plan upon receipt of FY 93 funds. The Plan outlines six specific projects plus a general project for technical services. The Plan has been useful to both MTDC and FPM in program management and gaging success. At the end of each fiscal year the Plan will be updated and an accomplishment report prepared. This document should be viewed as the first attempt to develop an accomplishment reporting system that reflects status of the FPM projects. Questions and comments are encouraged and should be directed to Harold Thistle (MTDC), (406)329-3981; to Jack Barry (WO/FPM), (916)758-4600; or to the project leaders listed under each project.

I. THERMAL INSECT CONTROL

Project Leader -
Keith Windell (406)329-3956

Project Description

The objective is to kill insect larvae in seed orchards before they emerge from the cones or from the duff layer. It has been shown that this is an opportune time in the insect's life cycle to rid the orchard or at least lesson the effect of the insect.

Background

Historically, prescribed fire has been found effective in killing larvae but ideal burning conditions do not always occur prior to emergence. If the insect emerges during the rainy season, prescribed fire is useless because it will not propagate through the orchard. It is speculated that a piece of equipment can be adapted or developed to allow for the control of seed cone and duff layer pests during their vulnerable larvae stage. The exact temperature and duration of heat required to kill different pests may vary and needs to be determined.

1. ACTION:

Develop contacts with people knowledgeable in the seed orchard pest management field in preparation for subsequent project work.

ACCOMPLISHMENTS - FY 93: The project leader has contacted experts and manufacturers regarding thermal insect control techniques and experience. MTDC learned of two equipment evaluations which are being conducted in FY 94 and is planning to attend both of these and participate as required. The first is being conducted by FPM in Region 9 and will focus on exterminating pests inside fallen cones. The second is being conducted by FPM Region 6 in cooperation with Oregon State University and is focused on killing insects in the duff layer.

ACCOMPLISHMENTS - FY 94: The project leader contacted experts and manufacturers regarding thermal insect control experiences and techniques. A literature search was conducted. The project leader attended and participated in two different equipment evaluations and submitted trip reports to the sponsor. One trip was to the Beaver Creek Seed Orchard (Oregon) to observe the effectiveness of a prototype field burner for killing Douglas-fir cone gall midges in the duff layer. Cooperators in the test included FPM (R6 - Portland), Oregon State University (Corvallis), and orchard personnel. The other trip was to the Oconto River Seed Orchard (Wisconsin) to observe the effectiveness of a commercial agricultural weed burner in killing white pine cone beetle larvae while they are overwintering in the

cones. Cooperators in the test included FPM (NA S&PF - St. Paul, MN) and orchard personnel. Since trials at both orchards were not completely successful alternative concepts were developed. A market search was conducted to determine price and availability of equipment for concepts. A progress report for FY 94 activities was generated and submitted to the sponsor. A short DG survey is in the process of being distributed to federal seed orchards to determine, among other things, what budget constraints for alternative concepts must be taken into account.

Reference: **Windell, K. 1994. FY 94 - Progress report - Thermal insect control. TA&S #4E32P11. USDA Forest Service, Missoula Technology and Development Center, Missoula, MT.**

II. TECHNICAL SERVICES

Project Leader -
Harold Thistle (406)329-3981

Project Description

The objective is to provide prompt technical services on request, and to coordinate program planning support to the sponsoring Washington Office unit. At the request of the Forest Pest Management Staff, the Center conducts special investigations and studies; participates in field programs; evaluates employee suggestions;contacts field personnel to determine instrumentation and equipment needs; delivers presentations on Forest Pest Management methods at training sessions, meetings, and workshops;
provides follow-up services on completed development projects and answers requests for information from field units, Government Agencies, and industry; publishes reports; prepares manuscripts for journal publications; and handles program planning and Washington Office coordinator activities for Forest Insect and Disease Management projects at the Center.

Background

MTDC represents a unique resource of people, knowledge, professional and technical skills, and is the only source of mechanical and electrical engineers in the Forest Service other than those in Research. Historically, FPM has called upon MTDC for immediate and short term professional judgements, on-site support, contract specifications, equipment evaluations, drafting, editing, publication, and assistance in Technology Transfer activities. Need for these services will, at a minimum, continue at current levels and likely will increase.

1. ACTION:

Perform technology transfer through attendance of national meetings and workshops, presentation of papers, and preparation of manuscripts for journal publications.

ACCOMPLISHMENTS - FY 93:

Technical Meeting Presentations

Touma, J.S., W.M. Cox, and H.W. Thistle. 1993. Statistical analysis of the performance of dense gas dispersion models. Presented at *american meteorological society, air and waste management association - the role of meteorology in managing the environment.* Scottsdale, AZ, January, 1993.

Thistle, H.W., M.E. Teske, and J.W. Barry. 1993. The relationship between in-canopy micrometeorology and droplet deposition. Presented at *1993 international summer meeting, american society of agricultural engineers and canadian society*

of agricultural engineers. Spokane, WA, 20-23 June.

Thistle, H.W., J.W. Barry, and M.E. Teske. 1993. Development and validation of the FSCBG model for the simulation of spray drift. Presented at the *second international symposium on pesticide application techniques.* Strasbourg, France. September, 1993.

Journal Articles

Two articles tentatively accepted into the *Journal of Environmental Engineering.* One article in preparation for the *Journal of Agricultural and Forest Meteorology.*

ACCOMPLISHMENTS - FY 94:

Technical Meeting Presentations

Thistle, H.W., J.W. Barry, and M.E. Teske. 1993. Computing total accountancy of aerially released material. Presented as a poster at *society of environmental toxicology and chemistry 14th annual meeting - ecological risk assessment: lessons learned?* Houston, TX, 14-18 November.

Thistle, H.W., M.E. Teske, and J.W. Barry. 1994. Penetration of aerially released material into forest canopies: A review of early work. Presented at *ASAE 1994 international summer meeting.* Kansas City, MO, 19-22 June.

Teske, M.E., J.W. Barry, and H.W. Thistle. 1994. Environmental fate and accountancy. Presented at *ACS symposium - biorational pest control agents: formulation and delivery.* San Diego, CA, 16-17 March.

Peer Reviewed Journals and Books

Thistle, H.W., D.R. Murray, M.R. Ratte, and M.R. Carroll. 1994. Atmospheric tracer concentrations from an elevated source in an urban core. *Journal of Environmental Engineering* (In Press).

Thistle, H.W., D.R. Murray, M.R. Ratte, and M.R. Carroll. 1994. Observed downwash concentrations compared to ISCST predictions in an urban core. *Journal of Environmental Engineering* (In Press).

Teske, M.E., J.W. Barry, and H.W. Thistle. 1994. Aerial spray drift modeling. In *Environmental Modeling Vol. II: Computer Methods and Software for Simulating Environmental Pollution and Its Adverse Effects*, ed. P. Zannetti, 11-42. Southhampton: Computational Mechanics Publications.

Touma, J.S., W.M. Cox, H.W. Thistle, and J.G. Zapert. 1994. Performance evaluation of dense gas dispersion models. *Journal of Applied Meteorology* (In Press).

Thistle, H.W., D.R. Miller, and J.D. Lin. 1994. The wind flow field through a forest edge: A comparison of foliated and unfoliated canopies. Submitted to *Journal of Agricultural and Forest Meteorology*.

Training Activities

MTDC ran training of four courses, meetings, or symposiums.

National Agricultural Aviators Association. Harold Thistle spoke on the role of meteorology in spray dispersion. Reno, NV, December 1993.

Workshop on Spray Drift Management - Can Computer Models Help? Harold Thistle spoke on the validation of computer models. Rotorua, NZ, February 1994.

National Pesticide Use Management Course. Five MTDC engineers and scientists gave lectures and presentations on topics ranging from spray physics to pump design. Marana, AZ, March 1994.

U.S. Department of Defense Aerial Application of Pesticides Certification Course. Harold Thistle spoke on the role of meteorology in spray dispersion. Youngstown, OH, June 1994.

II. TECHNICAL SERVICES

Project Leader -
Harold Thistle (406)329-3981

2. ACTION:

Act timely on routine requests and inquiries; including publishing, illustrating, and photographic support.

ACCOMPLISHMENTS - FY 93: MTDC has designated publication and photographic personnel to support project objectives. These services are routinely available to the FPM project leaders. Specific efforts this FY included full photographic support of the Region 4 Utah gypsy moth eradication project. MTDC also has publication staff to handle routine requests for publications. The project leader handles technical questions on a daily basis.

ACCOMPLISHMENTS - FY 94: MTDC/FPM publication and photographic personnel were used to develop photo-ready manuscripts for the above-mentioned journal articles. The photographic support was used to develop slide shows for the various training courses. Requests were also made directly from the FPM sponsor and FPM regional personnel which were completed.

II. TECHNICAL SERVICES

Project Leader -
Harold Thistle (406)329-3981

3. ACTION:

Provide meteorological measurement and consultation to support FPM field projects.

ACCOMPLISHMENTS - FY 93: Provided meteorological support including three baseline met towers, a ridgetop station and various special projects in the Wasatch Front as part of *Bacillus thuringiensis* - Drift/Dispersion and Effects on Non-Target Lepidoptera, Utah 1993 - Phase III.

Provided meteorological instrumentation in support of Gypsy Moth Larvae Survival Study sponsored by the State of Utah and Region 4. The meteorological data were used in go/no-go decisions by the Region 4 staff. The data were archived for later use in spray drift model validation.

ACCOMPLISHMENTS - FY 94: Provided meteorological support to the Peach Twig Borer Study, February 1994, in Chico, CA. This study involved transfer of Forest Service aerial application technology to agriculture using a biological insecticide. Provided meteorological support to Region 4 background gypsy moth monitoring work July-August 1994. Provided meteorological support to the second year of the Gypsy Moth Larvae Survival Study run by the State of Utah and Region 4.

Harold Thistle serves as chairperson of the Meteorological Sub-committee of the USDA-FS National Spray Model and Application Technology Steering Committee. The sub-committee has prepared a draft document on meteorological measurements necessary for computer modeling of aerial spraying.

II. TECHNICAL SERVICES

Project Leader - .
Harold Thistle (406)329-3981

4. ACTION:

Coordinate MTDC project capabilities with requests from Regions, Stations, NA, WO, and FPM units.

ACCOMPLISHMENTS - FY 93: MTDC attended national steering committee meetings for Seed and Cone Insects, Western Defoliators, Gypsy Moth and Eastern Defoliators, and Spray Model and Advisory. In this way the Center keeps in touch with developments and needs Forest Service wide. The FPM program works frequently with personnel from all regions. We currently have cooperative efforts with Region 4 and Region 6. We are in frequent touch with personnel from Regions 1, 8, and 9. We are responsive to suggestions and needs of FPM units nationwide.

ACCOMPLISHMENTS - FY 94: MTDC attended steering committee meetings for the Spray Model and Application Technology Committee, Western Defoliators, and Seed and Cone Insects. Harold Thistle has attended meetings with other units at the National Forest Health Center in Morgantown, WV and the Plant Insect and Disease Laboratory in Hamden, CT. We have worked this FY with FS personnel in CA, UT, ID, CT, WV, OR, MT, WI, MI, AR, NC, SC, and others. MTDC has also established substantive contacts with USDA-APHIS and USDA-ARS.

II. TECHNICAL SERVICES

Project Leader -
Harold Thistle (406)329-3981

5. ACTION:

Complete reports for terminated projects and status reports.

ACCOMPLISHMENTS - FY 93: A first draft of the report on the Block Marking Project was completed in October 1993. Trip reports are prepared and filed on a regular basis, and are available on request.

ACCOMPLISHMENTS - FY 94: The Block Marking Report is in press and the project is completed.

II. TECHNICAL SERVICES

Project Leader -
Harold Thistle (406)329-3981

6. ACTION:

Initiate new projects as directed by FPM/WO (assignments subject to revision as needs change).

ACCOMPLISHMENTS - FY 93: MTDC responded to a request from WO/FPM to design a system for a stationary sprayer to do single-tree spraying in response to an FPM need to protect rust-resistant sugar pine cones. MTDC cooperated with FPM, Sierra National Forest, and PSW on this project and performed a preliminary field evaluation in central California. Preliminary results are promising and the system performed as designed. Testing by Sierra National Forest is continuing.

ACCOMPLISHMENTS - FY 94: MTDC has responded to a request from R-6 to investigate systems to computerize the regional forest health inventory which is currently done through a manual sketchmapping approach. MTDC has attended a system demonstration that has system capabilities very close to those desired. Preliminary investigation indicates that the desired technology is available but will probably take some customization and integration.

III. TECHNICAL TRANSFER OF COMPUTER MODELS

Project Leader - Harold Thistle (406)329-3981

Project Description

The objective of this project is to support the technical transfer of models that support the safe and effective application of pesticides. Mathematical models have been developed that use descriptions of meteorological processes and descriptions of the application methods and equipment to simulate dispersion and deposition of airborne materials. Analysis of data is on-going and models have been improved and verified based on field trials. Training in the use of the models began in FY 1988 and will continue as the models evolve and become more sophisticated. In FY 95, a complex terrain dispersion model will be incorporated into the FS system of models.

Background

MTDC has played an integral role in the development of the FS spray dispersion models. The modeling system currently in use (FSCBG) consists of two basic model types with a third to be added this year. The far-field model is Gaussian and has been adopted from U.S. Army models. The near field model is a LaGrangian transport model which has been developed under contract to the FS, the third and newest part is a phenomenological model describing transport in complex terrain. Both the near field and the complex terrain models have been developed under contracts overseen through MTDC.

1. ACTION:

Continue to provide support for systems management and implementation of existing spray and other models plus support the introduction and application of new models to users.

ACCOMPLISHMENTS - FY 93: The pesticide spray droplet evaporation study was completed in FY 93 and a final report was received in June. The results for water were tested against the model and the agreement was very good. Results for BT will be used to upgrade the FSCBG model. The complex terrain field and model work continued in FY 93. The VALDrift module for simulating pesticide flow in mountain valleys is being developed by Battelle Pacific Northwest Laboratories under USDA-FS sponsorship. The module has been written and is currently in the process of being tested against existing data gathered in R-4. There are numerous other model development tasks which are undertaken at the behest of the various FPM steering committees, based on other user concerns, or due to model performance questions raised by validation tests. Among those being considered is a full evaluation of the in-canopy treatment in the model and a full evaluation of the source algorithm.

ACCOMPLISHMENTS - FY 94: Harold Thistle of MTDC participated in a workshop in Rotorua New Zealand with the goal of exchanging information with New Zealand users of USDA Forest Service spray dispersion models. This was a very informative exchange.

MTDC received the VALDrift model from Battelle - Pacific Northwest Laboratories. This model will be incorporated into the FSCBG system of models and allows a more realistic simulation of atmospheric dispersion and deposition in complex terrain. A substantial effort will be conducted in the coming year to interface this model into FSCBG. Other model development efforts involve introduction of a ground sprayer model in the FSCBG system as well as an edge model that could handle dispersion near windbreaks, woodlots, and forest edges. A further focus is to develop a simplified drift model which could be used in conjunction with a GPS positioning system as an on-board alarm to notify a spray pilot that off-target drift may be exceeding a threshold limit.

IV. BLOCK MARKING METHODS GUIDE

Project Leader -
Harold Thistle (406)329-3981

Project Description

The objectives are to assemble practical information and publish a guide on methods of marking areas to be aerially treated with pesticides. A guide needs to be published describing each method, the equipment, and the advantages and disadvantages of each. The cost of each device as well as the actual cost of marking needs to be included. Marking procedures should also be analyzed to consider and evaluate safety, and the effects of differences in vegetation, composition, and structure also need to be considered.

1. ACTION:

Develop a Total Project Work Plan for sponsor review.

ACCOMPLISHMENTS - FY 93: This task was only on the five-year plan in FY 93. WO/FPM indicated that the deliverable document should be a short summary report which in many ways updates previous MTDC work.

IV. BLOCK MARKING METHODS GUIDE

Project Leader -
Harold Thistle (406)329-3981

2. ACTION:

Contact key specialists and assemble pertinent information for block marking methods.

ACCOMPLISHMENTS - FY 93: A summary document of contacts and relevant comments has been produced and will be paraphrased and included in the final report. Contacts were made in most Forest Service regions, APHIS, academia, and private industry.

IV. BLOCK MARKING METHODS GUIDE

Project Leader -
Harold Thistle (406)329-3981

3. ACTION:

Conduct market literature search and through appropriate contacts, establish an outline for the guide. Conduct appropriate analysis for systems and methods.

ACCOMPLISHMENTS - FY 93: The guide will consist of a discussion of available methods and advantages/disadvantages of the various methods based on discussion with experts. Manufacturers will be listed where appropriate, although based on discussions to date, some of the methods currently used are based upon generic component materials (safety orange sheet cloth, for example) which is fashioned by the user.

IV. BLOCK MARKING METHODS GUIDE

Project Leader -
Harold Thistle (406)329-3981

4. ACTION:

Prepare memo reporting on findings and future actions.

ACCOMPLISHMENTS - FY 93: A detailed document will be available in draft form by the end of October 1993. The document discusses current techniques and will recommend that most of this work can now be done using GPS technology. Certain special applications may require traditional block marking methods.

ACCOMPLISHMENTS - FY 94: Completed (Report is in Press).

V. GROUND AND AERIAL PHEROMONE APPLICATOR EVALUATION

Project Leader -
Diane Herzberg (406)329-3957

Project Description

The overall objective is to help make available equipment and procedures for applying pheromones both aerially and on the ground. Methods and equipment need to be investigated, evaluated, and possibly developed for dispersing pheromones in tubes, capsules, flakes, pellets and granules. Investigate solid dispersal systems, how pheromones are currently dispersed, and in what forms they can be obtained. Included is the necessary familiarization and training in related software and test procedures, as well as planning and coordination. Field testing will be accomplished, hardware modified if necessary, and progress documented.

Background

Pheromones are chemical substances released by animals and insects, and provide an odor that becomes a means of communication between species. The release of pheromones is sometimes used to establish territories, provide a warning mechanism, or to attract other members of the same species. Pheromones are usually gaseous in the natural state. These pheromones can be produced synthetically and can be used to cause communications disruption between the insects or used to warn the insects to leave the area. Because the pheromones are usually gaseous, there has to be a mechanism built into the synthetic product to allow controlled release over a period of time. The time release mechanism is accomplished by encapsulating the pheromones in plastic polymers that will break down over time. The end product can be packaged in many forms, from plastic granules to spaghetti like tubes or strings and are aerially applied with adapted granule applicators or manually placed in the treatment area.

1. ACTION:

Develop contacts with people knowledgeable in the pheromone application field in preparation for subsequent project work.

ACCOMPLISHMENTS - FY 93: Numerous contacts have been made in the field of pheromone application technology including experts from USDA-FS, APHIS, and the private sector. MTDC plans to participate in equipment evaluation in the coming year based on these contacts.

ACCOMPLISHMENTS - FY 94: Obtained literature and information from researchers and manufacturers on pheromone application techniques and studies.

Established contact and toured facilities of pheromone researchers at Simon-Fraser University. Established field contact with contract pheromone applicators to determine what equipment is being used to apply the pheromone dispensers. (K&K Aircraft, Harold Millers Flying Service.) Worked with Forest Service and ARS researchers along with APHIS and state agency personnel on experimental and Slow The Spread gypsy moth pheromone applications in Virginia and West Virginia.

Examined a bark beetle pheromone study being conducted by Region 1 entomologists. Examined traps and dispensers being used.

Established contact with several pheromone manufacturers: Pherotech, Inc.; Hercon Manufacturing; AgriSense; and Scentry. Conducted field trips to Hercon and Pherotech. Obtained sample dispensers and ground dispensing equipment from Hercon, Pherotech, and AgriSense.

V. GROUND AND AERIAL PHEROMONE APPLICATOR EVALUATION

Project Leader - Diane Herzberg (406)329-3957

2. ACTION:

Prepare for and give presentation at March 1994, FPM training session in Arizona.

ACCOMPLISHMENTS - FY 94: Prepared and presented a 1-hour training course on ground and aerial pheromone application equipment and a 1/2 hour presentation on rotary atomizers.

VI. CHARACTERIZING SPRAY FROM GROUND SPRAYERS

Project Leader -
Harold Thistle (406)329-3981

Project Description

The objective of this project is to make it possible to predict ground spray behavior by characterizing the spray plume, spray deposition, and spray drift from ground sprayers used in seed orchards, and then evaluating and modifying the FSCBG model system for use in predicting drift from ground application of pesticides.

Background

Computer models are used to predict the airborne drift of pesticides released from aircraft in aerial spraying. In order to utilize these models, it was necessary to first determine the characteristics of the aerial spray droplets. Nozzle and droplet distributions for ground applications differ from those of aerial applications. For modelling purposes, it is necessary to know the exit speed and angle of droplets exiting the nozzles. The FSCBG aerial spray model system was developed for aerial application of pesticides. It is widely used for that purpose and there are large groups of trained users. The near field model (AGDISP, LaGrangian transport model) has a ground application module, but it has never been validated. It is anticipated that the software will have to be modified based on the experimental data obtained.

1. ACTION:

Develop a total project work plan for sponsor review.

ACCOMPLISHMENTS - FY 93: The work plan is pending subject to receipt of an existing algorithm for performing this task. The work plan will be submitted within the next six months.

ACCOMPLISHMENTS - FY 94: A draft study plan has been written and has undergone one review. A final plan will be published in 1995.

VI. CHARACTERIZING SPRAY FROM GROUND SPRAYERS

Project Leader - Harold Thistle (406)329-3981

2. ACTION:

Survey ground spray equipment currently used in seed orchards. Select ground sprayers and configurations to characterize.

ACCOMPLISHMENTS - FY 93: Under direction of the sponsor, it has been decided to focus this task on air-blast sprayers. This type of sprayer utilizes a high velocity air-stream to transport the spray material. This type of sprayer is commonly used to treat orchards and more closely imitates aerial spraying than other ground sprayers but is also more susceptible to off-target drift. Sprayer configurations and models have not yet been determined.

VI. CHARACTERIZING SPRAY FROM GROUND SPRAYERS

Project Leader - Harold Thistle (406)329-3981

3. ACTION:

Identify objective for models, set criteria for evaluation, and develop evaluation protocols.

ACCOMPLISHMENTS - FY 93: An appropriate ground sprayer model has been identified and MTDC is in the process of obtaining this model. Final transfer arrangements will be made in September, 1993. Two separate model validation plans/protocols have been received at MTDC and these will be used to develop a USDA-FS protocol.

ACCOMPLISHMENTS - FY 94: This model was not received due to complications regarding ownership and the reluctance of the developer to release it. However, Spray Drift Task Force (SDTF) and US Environmental Protection Agency (EPA) have also been working on drift from ground sprayers and are developing a second model that will focus on drift as opposed to near field transport. The model is a random walk model and this type of model has not been received favorably by EPA. A draft study plan is in existence and preliminary ground trials have been run in New Zealand to assist model development and validation. We plan to conduct joint trials in New Zealand during 1995.

VI. CHARACTERIZING SPRAY FROM GROUND SPRAYERS

Project Leader - Harold Thistle (406)329-3981

4. ACTION:

Consult with and select one or more Regional cooperators for field evaluation.

ACCOMPLISHMENTS - FY 93: MTDC received ground sprayer validation protocols from Region 8 and the SDTF (the latter was under the conditions of peer review and is not to be directly copied). Ed Monnig of R-1 has been contacted with regard to two proposed ground sprayer validation projects and will likely cooperate in at least one.

ACCOMPLISHMENTS - FY 94: Cooperators have been chosen from the Forest Research Institute (FRI) in Rotorua, NZ and the Agricultural Engineering Institute (AEI) in Hamilton, NZ. This relationship was established because these groups were planning similar work and through cooperation with them the economics are such that FS can conduct a much more sound, significant set of characterization trials.

VI. CHARACTERIZING SPRAY FROM GROUND SPRAYERS

Project Leader - Harold Thistle (406)329-3981

5. ACTION:

Develop procedures and inputs for ground use of FSCBG and AgDISP aerial spray models.

ACCOMPLISHMENTS - FY 93: AgDISP can currently be used in ground sprayer mode, however, it is unvalidated. It is planned to perform testing in FY 94 of AgDISP interfaced into FSCBG. Subsequent to the receipt of the ground sprayer model from the UK, an analysis will be performed to determine how best to proceed and what additional FSCBG inputs will be required.

ACCOMPLISHMENTS - FY 94: It was decided that the model will be a stand alone source module in the FSCBG modeling system. Most of the inputs will be the same with the exception of the source menu which will be created to include specific types of ground sprayers. The setting up of the source will parallel what is currently done for airplanes.

VI. CHARACTERIZING SPRAY FROM GROUND SPRAYERS

Project Leader - Harold Thistle (406)329-3981

6. ACTION:

Select drift samplers and procedures for collecting and analyzing data.

ACCOMPLISHMENTS - FY 93: Two ground sprayer evaluations have been planned for FY 94. One would be a cooperative effort with the Forest Research Institute (FRI) in New Zealand. A detailed model evaluation protocol will be prepared and details will be negotiated with FRI. The details of the equipment which will be used will be largely determined by logistics, although a primary rationale for performing cooperative work with FRI is that they have certain resources not easily available in the U.S.

The second field evaluation which has been discussed is an evaluation to take place in northwestern Montana. Sampling details have not yet been decided, although the sampling program would probably rely on Rotorods and deposit cards with possible inclusion of a real time particle analyzer belonging to Dugway Proving Ground.

ACCOMPLISHMENTS - FY 94: This effort will now focus on cooperation with New Zealand's FRI and Agricultural Engineering Institute.

VI. CHARACTERIZING SPRAY FROM GROUND SPRAYERS

Project Leader -
Harold Thistle (406)329-3981

7. ACTION:

Conduct Field Trial.

ACCOMPLISHMENTS - FY 94: Field trials were conducted in April, May 1994 by AEI and FRI. The main trials are scheduled for May 1995. A draft test plan exists and a meeting was held between USDA-FS and New Zealand in Hamilton, NZ in January 1994 to begin discussing the logistics of the experimental design. Suggestions during that meeting were incorporated into the field trials conducted in May 1994.

VII. AIRCRAFT GUIDANCE

Project Leader -
Harold Thistle (406)329-3981

Project Description

The objective of this project is to help make available a guidance tracking system for spray aircraft. In aerial spraying it is important to apply pesticide as accurately as possible in order to improve its efficiency and thereby reduce costs and the impact on the environment. It is also important to know aircraft location in real-time and to have a permanent record of its flight patterns. Therefore, some type of guidance\tracking system is a must. A guidance system is needed to assist the pilot in the precise application of the material and a tracking system is needed to provide a record of where the aircraft flew for later analysis of the operation, or input into GIS for future information and possible future litigation. In the post analysis of the operation, skips can be determined and respray accomplished.

Background

In the past Loran-C and many other systems have been looked at for use as a guidance tracking system for spray aircraft. Most were found unsuitable for a variety of reasons including cost, terrain obstacles interfering with the signal, accuracy, etc. However, the Department of Defense's Global Positioning System (GPS) offers accuracy of better than 5m. This is capable of providing tracking and guidance information, and can be entered as a GIS overlay. These systems have application in many other areas such as photogrammetry, aerial surveys, remote sensing, etc.

1. ACTION:

Develop a total project work plan for sponsor review.

ACCOMPLISHMENTS - FY 93: A draft action plan will be to the sponsor for review by November 30, 1993.

ACCOMPLISHMENTS - FY 94: A test plan for the GPS Aircraft Guidance Evaluation/Demonstration has been prepared and distributed.

VII. AIRCRAFT GUIDANCE

Project Leader -
Harold Thistle (406)329-3981

2. ACTION:

Investigate current navigation equipment capabilities and limitations with Path Link and other systems (R-6, R-8, APHIS, MAG, USCG) and applicable applicators and manufacturers.

ACCOMPLISHMENTS - FY 93: MTDC has developed a large reference file of equipment manufacturers and has talked to numerous users of aerial guidance systems. USDA-FS and USDA-APHIS personnel have been contacted. MTDC is planning to participate in evaluations by academia, manufacturers, APHIS, and operators.

ACCOMPLISHMENTS - FY 94: MTDC staff attended four demonstrations at Puyallup, WA; Marana, AZ; Mio, MI, and Phoenix, AZ of GPS navigation/guidance systems in FY 94. William Kilroy of MTDC conducted a phone survey of FS and others involved in the actual use and operation of GPS navigation/guidance systems in FY 94 and an interim summary report based on these phone conversations and various reports prepared nationwide is being prepared. An announcement of FS intent to conduct an equipment demonstration in the Consumer Business Daily (CBD) turned up many companies interested in our demonstration.

VII. AIRCRAFT GUIDANCE

Project Leader -
Harold Thistle (406)329-3981

3. ACTION:

Conduct market search and interview users of all systems.

ACCOMPLISHMENTS - FY 93: A large file of manufacturers has been compiled and numerous contacts in government and industry have been made. MTDC personnel participated in an evaluation of GPS technology in aerial guidance in February 1993 at Las Cruces, NM. The GPS system performance was remarkable as APHIS pilots duplicated unmarked flight lines within 2 meters in the desert with few landmarks. A trip report was filed with the sponsor.

Project Leader -
Harold Thistle (406)329-3981

4. ACTION:

Analyze the results of the investigation and interviews and issue a report.

ACCOMPLISHMENTS - FY 93: An analysis based on the previous work has led to the conclusion that GPS technology is the future in this area. There are still some important questions to be answered regarding selective interference by DOD and system performance in complex terrain.

VII. AIRCRAFT GUIDANCE

Project Leader -
Harold Thistle (406)329-3981

5. ACTION:

Summarize recommendations and alternatives.

ACCOMPLISHMENTS - FY 93: GPS technology should be pursued and integrated into control systems that will allow automated, accurate logging of position, optimize travel to loading zones, optimize coverage, and address various questions which can arise in litigation. All alternatives fall far short of the GPS capability. USDA-FS will monitor DOD policy with regard to this satellite network.

ACCOMPLISHMENTS - FY 94: An interim report is being prepared which will summarize FS experience in the FY 94 field season. MTDC has compiled a set of project reports from around the country which will be summarized. MTDC personnel have now witnessed demonstrations of systems by four manufacturers and these experiences will be included in the interim report. MTDC personnel have been invited to speak at two separate meetings to discuss findings regarding GPS navigation.

VII. AIRCRAFT GUIDANCE

Project Leader -
Harold Thistle (406)329-3981

6. ACTION:

Publish a reference/source book.

ACCOMPLISHMENTS - FY 93: MTDC has compiled extensive information regarding aerial guidance systems. However, the rapid evolution of this technology has made it impractical to "freeze it" at a point in time for inclusion in a book. Based on recent discussions with the sponsor, MTDC will pursue the creation of a source book based on current information in FY 94.

ACCOMPLISHMENTS - FY 94: MTDC will prepare a final project report which will include results and description of the evaluation/demonstration, the interim report and discussion/recommendations regarding equipment. This is the document which will be focused upon in FY 95. The reference/source book will be based on this document.

VII. AIRCRAFT GUIDANCE .

Project Leader -
Harold Thistle (406)329-3981

7. ACTION:

Proceed with field testing and evaluation based on above recommendations, including implementing and documentation as appropriate.

ACCOMPLISHMENTS - FY 94: MTDC is conducting field testing on the Nine-mile Ranger District in October 1994. This is both a test and a demonstration for FS personnel and others interested in this technology. Over 125 notifications have been sent to potential observers and three GPS navigation equipment manufacturers will participate. These tests will be thoroughly documented and reported upon.

VIII. SINGLE TREE APPLICATORS

Project Leader -
Diane Herzberg (406)329-3957

Project Description

The objective of this project is to design and produce an inexpensive semi-permanent spray system to install in high value trees for the purpose of applying repeated spray treatments. In certain valuable seed trees, it may be economically feasible to install a semi-permanent sprinkler system to apply pesticide. By 'hard-wiring' to the tree of interest, off target material and drift can be minimized. In correctly designed systems, a tank of material would be hooked directly into the single tree system and pumped out the sprinkler which is near the top of the tree.

Background

This system was first deployed as a special project by MTDC in cooperation with PSW to combat cone insects in white pine. Certain white pine trees have shown resistance to blister rust. Therefore, the cones of these specific trees are very valuable. Since these rust resistant trees are widely dispersed in the Sierra Nevadas, it is not feasible to perform a wide area application when only single trees are the targets. Since this initial use of this type of system, a second set of prototype systems are being tested in a seed orchard in Idaho.

ACTION:

Initiate formal project, continue CA testing and initiate further trials of single-tree applicator.

ACCOMPLISHMENTS - FY 94: Worked with the Coeur d'Alene Nursery to develop a study to compare a single-tree spray system with the hydraulic sprayer system the nursery currently uses to apply pesticides. Ten systems were installed in the tree improvement orchard and one application was conducted in June.

The systems installed in sugar pine trees in California were tested in June 1993. Two of the three systems were operational. The cause of failure was not determined on the non-functioning sprayer.

Single-tree systems were installed in seven trees in the Lookout Pass area on the Montana/Idaho border. The purpose of installing the systems was to determine how durable the systems are after exposure to the elements.

Trip reports are available on request.